**:::::::Library:Application Support:Microsoft:Office:Clipart:Personal:j0440424.wmf3.1 Reading Guide**

**What is Earth’s Tilt?**

**Read page 67 and complete the chart below.**

|  |  |
| --- | --- |
| **Axis** | **Rotation** |
| **Revolution** | **How many days does it take Earth to revolve around the sun?** |

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**Explore**

Read page 67 and create a model of a planet rotating on its axis.

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**Stop and Think**

1. Rotation and revolution are two different movements a planet makes. Describe the movement of a planet when it rotates. Now, describe the movement of a planet when it revolves. Which of these movements is responsible for the length of a day?

2. What happens to the direction of Earth’s axis as Earth revolves around the Sun?

**Prediction**

1. Describe your prediction of how the tilt of a planet affects surface temperature.
2. Do your best to explain why tilt may or may not affect a planet’s surface temperature.
3. Based on what you know so far, how confident are you about this prediction and explanation?
4. Below are some students’ ideas about how tilt may affect a planet’s surface temperatures. As you are reading, think about your responses to each students’ idea.
   1. What would you say to each student?
   2. What idea would you want to investigate further?

*Sasha:* “The Equator is always hot, so I do not think the tilt changes surface temperatures much.”

*Lakiska:* “Australia is hot sometimes and cold sometimes. Australia’s seasons are opposite of the Northern Hemisphere. The tilt may actually be the reason for this. Sometimes Australia is tilted toward the Sun and sometimes not.”

*Madison:* “I do not think tilt changes anything. The North and South Poles are both cold. If tilt was a factor, one pole would be cold and the other would be warm.”

*Troy:* “I think the tilt causes days in Alaska to be short. I heard that Alaska has days when the Sun comes up and then sets a few hours later. Less Sun means less solar energy and lower temperatures.”

**Update the Project Board **

As a class share your answers to the questions above by completing the *What do we think we know? column and What do we need to investigate? column.*

**What is the Point?**

Read and summarize the main ideas.

**3.2 Reading Guide**

**How Does Tilt Affect the Amount of Incoming Solar Energy?**

**Investigate:** At the end of this investigate you will be able to answer the questions below by creating model/simulation of the Earth orbiting the Sun.

As a class discuss what will happen.

• What happens to the directness of incoming solar energy on different parts of the planet as Earth, tilted at 23.5°, revolves around the Sun?

• What happens to the number of daylight hours on different parts of the planet as Earth, tilted at 23.5°, revolves around the Sun?

**Prediction:** Complete the predictions below by circling more direct, equally direct or less direct for each prediction.

•If the North Pole is tilted away from the Sun, then the Northern Hemisphere will receive incoming solar energy that is **(*more direct* *than, equally direct as, less direct than*)** the Southern Hemisphere.

• If the North Pole is tilted away from the Sun, then the Northern Hemisphere will have **(*more, the same, fewer*)** daylight hours than the Southern Hemisphere.

**Build and Run Your Participatory Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Month | Latitudes receiving most direct solar energy | Latitudes receiving least direct solar energy | Latitudes receiving no solar energy at all | Latitudes receiving 24 hours of solar energy |
| December |  |  |  |  |
| March |  |  |  |  |
| June |  |  |  |  |
| September |  |  |  |  |

pe02945_1 **Analyze Your Data**

1. Draw a diagram of Earth’s orbit around the Sun. Label the position of the Earth in December, June, September, and March. (Remember that the Earth’s North Pole is always pointing to the North Star.)

2. When Earth’s North Pole is tilted away from the Sun, the Northern Hemisphere receives less direct solar energy at any time of day than locations in the Southern Hemisphere.

Explain how this affects surface temperatures.

What would you expect to see on a temperature map for December?

3. When Earth’s North Pole is tilted toward the Sun, the Northern Hemisphere receives more direct solar energy at any time of day than locations in the Southern Hemisphere.

Explain how this affects surface temperatures.

What would you expect to see on a temperature map for June?

4. Geoconda lives in Quito, Ecuado. It is near the Equator. Geoconda says: “The amount of solar energy we receive is pretty much the same all year. It is fairly constant because the amount of direct sunling striking this area does not change much throughout the year. “Do you agree with Geoconda? Explain your reasoning.

5. Helmut lives in Reykjavik, Iceland. It is in the North Atlantic at about 69 degrees North Latitude. Helmut says: “The amount of solar energy we receive varies a lot throughout the year. There are times when we are getting more direct sunlight, and other times we are receiving less direct sunlight. In December, we get about 4 hours of sunlight and in June we get about 21 hours of sunlight. The amount of direct sunlight changes throughout the year. “Do you agree with Helmut? Explain.

6. Ona lives in Melbourne, Australia, at about 34 degrees South latitude. Oana wrote that the amount of solar energy remains fairly constant there. ‘We get aout the same amount of sunlight each day throughout the year.” Do you agree with Oana? Explain your reasoning.

7. Planet Y is round like Earth but **not** tilted. Describe the surface temperatures of Planet Y throughout the year.

8. Planet Z is round like Earth and tilted like Earth. Describe the surface temperatures of Planet Z throughout the year.

9. How does tilt influence the surface temperature of Earth?

**Explain**

Your challenge is to determine the effects of tilt on the surface temperatures of a planet. Remember you observed how tilt affects the directness of sunlight striking a planet’s surface. You also learned that the directness of incoming solar energy affects temperature. Using this information you can now **create an explanation about the relationship between** **tilt and temperature**.

Using the ***Create Your Explanation* page**, write an explanation of your own. Be sure to includeevidence from your investigation and your own knowledge. Share your completed explanation with your group.

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**Communicate**: Discuss several explanations as a class.

**What is the Point?** Read as a class.

**Planetary Forecaster**

**How Does Earth’s Tilt Affect Surface Temperatures at different Latitudes?**

**LS 3.3**

**Look at how Earth’s surface temperatures vary throughout the year.**

Read the first paragraph on page 77.

**Predict**

Write a prediction by completing the following sentences.

• If tilt is a factor affecting Earth’s temperature, then temperatures near the Equator will vary

**(*a lot, a little,* *or some*).**

• If tilt is a factor affecting Earth’s temperature , then temperatures at mid-latitudes will vary

**(*a lot, a little, or some*).**

• If tilt is a factor affecting Earth’s temperature, then temperatures at the poles will vary

**(*a lot, a little, or some*).**

**Procedure:** Read and follow the procedure on pages 77 & 78 and collect data on monthly temperatures at certain locations.

**Recording Your Data**

Record Data on the **Monthly Temperature**s sheet located on the back of this page.

1. Collect average monthly temperature data for each of these locations.
2. Record the temperature to the nearest degree.
3. Put a circle around the yearly high temperature for each location.
4. Put a square around the yearly low temperature for each location.

**Analyze Your Data**

Calculate the temperature range for each location using a table titled Temperature Ranges.

**Reflect:** Answer these questions to help you summarize what you have learned from your investigation. Remember, you were attempting to determine how the tilt of a planet affects the temperature at different latitudes.

1. Which latitudes have the smallest change in temperature throughout the year?

Why do you think that happens?

2. Which latitudes have the largest change in temperature throughout the year?

Why do you think that happens?

3. In which months are the temperatures in the Northern Hemisphere the highest? The lowest?

Highest:

Lowest:

4. In which months are the temperatures in the Southern Hemisphere the highest? The lowest?

Highest:

Lowest:

**What’s the Point?** How did the change in temperatures affect the tropics, poles and Northern Hemisphere?

**Planetary Forecaster**

**What is the Relationship between a Planet’s Tilt and its Seasons?**

**LS 3.4**

Read page 83 & 83.

|  |  |
| --- | --- |
| Paragraph 1 (bottom pg. 82 and top of 83)  Main Idea: | Facts to Support Main Idea |
| Paragraph 2 (pg. 83)  Main Idea: |  |
| Paragraph 3 (pg. 83)  Main Idea: |  |
| Paragraph 4 (pg. 84)  Use the Average Hours of Daylight Chart . | What patterns do you see? |
| Paragraph 5 (pg. 84) |  |
| Paragraph 6 (pg. 84)  Use the Average Hours of Daylight Chart . | When do different places experience their summer solstice and winter solstice? |

**Stop and Think**

1. The Northern Hemisphere experiences summer solstice in June. When do you think the Southern Hemisphere experiences summer solstice?

2. The Northern Hemisphere experiences winter solstice in December. When do you think the Southern Hemisphere experiences winter solstice?

3. When does Helsinki, Finland experience the

\* Summer solstice (greatest number of daylight hours)?

\* Winter solstice (least number of daylight hours)?

4. When does Buenos Aires, Argentina experience the summer solstice? Winter solstice?

5. Which city in the table has the most variation in day length?

6. Which city in the table has the least variation in day length?

7. If the Northern Hemisphere experiences the spring equinox in March, when does the Southern Hemisphere experience the spring equinox?

8. When does the Southern Hemisphere experience the fall equinox?

9. When does Quito, Ecuador experience equinox?

10. Why are the hours of daylight the greatest during the summer?

11. Quito, Ecuador experiences warm tropical weather and about 12 hours of daylight all year. Chicago, Illinois experiences cold winters, hot summers, and warm spring and fall temperatures. Chicago’s longest daytime is about 15 hours, and its shortest is about 9 hours. Why are these two places different?

12. Cindy thinks it is hot in summer because Earth is closer to the Sun in the summer. Do you agree with Cindy? (Refer to page 85 pictures)

What would you say to Cindy?

**Update the Project Board**

Using the *What are we learning?* and *What is our evidence? columns* describe what you learned from the investigation and the science readings. Evidence includes data from investigations, as well as knowledge gained from other sources, such as reading, talking to experts, or media.

**Planetary Forecaster**

**Tilt and Temperature**

**Review and Revise Your Explanation**

**L.S. 3.5**

**Read paragraphs one and two on page 87.**

**Review and Revise your Explanation**

Earlier, your class wrote an explanation of how tilt affects surface temperatures. Review the explanation using what you learned from this last investigation. Use the following *Stop and Think* questions as a guide.

**Stop and Think**

Answer these questions on your own.

1. Describe your current understanding of how the tilt of a planet affects surface temperatures. Use evidence from your investigations to support your claim.

2. How has your claim changed since your earlier prediction? What have you learned that made you change it?

3. How has your understanding of why tilt affects surface temperatures changed since you started?

What have you learned that made you change your explanation?

4. Write a statement that combines the answers to *how*, *why*, and *how much* tilt affects surface temperatures. Make sure to use evidence fromyour investigations in your statement

**Explain**

Use the *Create Your Explanation* page to **rewrite** the explanation on your own. Then share it with a student next to you. As a class you will share your explanation with the class.

**Communicate**

Your class will meet to discuss the answers to these questions and the group explanations. *Antarctic Circle,*

**Update the Project Board**

You have now reviewed and revised your class explanation about how tilt affects surface temperatures. You will focus on columns *What are we learning?* and *What is our evidence?*

**Planetary Forecaster**

**Back to the Big Challenge**

**Learning Set 3**

**Use your data from the previous investigations and your final explanation to update your prediction about habitable areas of *Planet X*. The prediction that you have so far is an average over thewhole year and the axis is tilted at 23.5°, the same as Earth’s axis.Modify your predictions to show how tilt affects surface temperatures on *Planet X* in January and July. You will then use these temperature predictions to revise your map of habitable areas on *Planet X*.**

**Once you have updated your prediction, modify your prediction of habitable areas on *Planet X.***

**Procedure:**

You will now use the My World program to update your prediction maps. Follow the procedure on pages 90-94 .

* Prepare January Fields pages 90-91 .
* Prepare the July Fields using page 91-92
* Use the procedure on page 92-94 to create a new habitability map.

**Solution Briefing**

Your *Solution Briefing* should focus on the following points:

• Present the general look of your solution. Explain where temperature differences appear on your map.

• Tell others how the data you collected and science content you learned during this *Learning Set* support your decisions about the temperature on *Planet X*.

• Discuss how the class explanation of “shape” supports the solution you have created so far. If your map purposely does not match the explanation, tell your audience why this is so. Provide them with an explanation that better fits your idea.

**Reflect**

Answer the following questions. Be prepared to share your answers with your group and the class.

1. As the map was being created, what changes did you make that we do not see in the final map?
2. How well does the map match the explanation developed by the class as to how tilt affects surface temperatures?
3. Are there areas that do not seem to match the explanation?
4. Which areas were difficult to choose?

Which areas were easy to choose?

1. Are there any changes you might want to make on your map at this time?

If so, why?

**What is the Point? (Read)**

You have just used what you have learned about tilt to improve your original proposal to the Cooperative Space Agency. There are probably some areas you thought were habitable that you now know are not. As you learn about the other factors that affect surface temperature, you will continue to update your habitability predictions. Scientists do this all the time.

You have finished studying two of the four major factors that affect surface temperature. You still have to study the differences between land and water, and the effects of elevation. Your predictions for the habitable areas of *Planet X* will probably change as you investigate these factors in the next *Learning Sets*.